Robot Battery Rundown Test Plan

PackBot Modernization Project

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10/5/2012

A test plan to measure run down time of a battery-powered robot under several repeatable conditions.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
05 OCT 2012	**Technical Report**	**29-09-2012 to 05-10-2010**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Robot Battery Rundown Test Plan PackBot Modernization Project	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
Ty Valascho; Daniel Ryan	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army TARDEC,6501 East Eleven Mile Rd,Warren,Mi,48397-5000	**#23399**
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
U.S. Army TARDEC, 6501 East Eleven Mile Rd, Warren, Mi, 48397-5000	**TARDEC**
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)
	#23399

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

The views, opinion and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated.

14. ABSTRACT

A test plan to measure the amount of time a small robot rmains powered and functional using two standard Li-Ion batteries, under a variety of operating conditions.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Public Release**	**10**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Objectives

This test is intended to measure the amount of time a robot remains powered and functional using two standard Li-Ion batteries, under a variety of operating conditions.

Requirements

Special equipment

- Loading device to simulate operation of the Unit Under Test (UUT) at grade while ambient temperature is kept at specific temperatures: robot dynamometer, load rig, or treadmill
- Temperature measurement device

Site requirements

- None

Procedure

3 trials of each the following tests must be performed with valid completion.

Idle Test, -20 C

1. Measure and record State of Charge (SOC) of 2 fully charged BB-2590 batteries (NSN 6140-01-490-4316, 6.8 Ah @ 28.8 V).
2. Place UUT and the 2 batteries inside the temperature chamber. The batteries are not to be installed in the UUT at this time.
3. Install ambient temperature sensor inside the chamber to measure inside air temperature
4. Monitor and log the power bus voltage of the platform. Rate of datalogging should be at least 0.1 Hz.
5. Bring temperature of chamber to -20 C and soak UUT and batteries for 2 hours.
6. Begin logging of data, monitoring power bus voltage.
7. Power on the UUT's Operator Control Unit (OCU). Verify OCU is completely powered on before proceeding to the next step.
8. Open the chamber for no more than 1-minute maximum; install batteries into the UUT and power on UUT.
9. Connect and verify communication to the UUT
10. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.
11. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
12. If an invalid test, note the error or conditions which resulted in the end of test.

Idle Test, +25 C

1. Measure and record State of Charge on 2 fully charged BB-2590 batteries (NSN 6140-01-490-4316, 6.8 Ah @ 28.8 V).
2. Place UUT and the 2 batteries inside the temperature chamber. The batteries are not to be installed in the UUT at this time.
3. Install ambient temperature sensor inside the chamber to measure inside air temperature. Rate of datalogging should be at least 0.1 Hz.
4. Monitor and log the power bus voltage of the platform.
5. Bring temperature of chamber to +25 C and soak UUT and batteries for 2 hours.
6. Begin logging of data, monitoring power bus voltage.
7. Power on the UUT's Operator Control Unit (OCU). Verify OCU is completely powered on before proceeding to the next step.
8. Open the chamber for no more than 1-minute maximum; install batteries into the UUT and power on UUT.
9. Connect and verify communication to the UUT
10. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.
11. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
12. If an invalid test, note the error or conditions which resulted in the end of test.

Idle Test, +50 C

1. Measure and record State of Charge on 2 fully charged BB-2590 batteries (NSN 6140-01-490-4316, 6.8 Ah @ 28.8 V).
2. Place UUT and the 2 batteries inside the temperature chamber. The batteries are not to be installed in the UUT at this time.
3. Install ambient temperature sensor inside the chamber to measure inside air temperature. Rate of datalogging should be at least 0.1 Hz.
4. Monitor and log the power bus voltage of the platform.
5. Bring temperature of chamber to +50 C and soak UUT and batteries for 2 hours.
6. Begin logging of data, monitoring power bus voltage.
7. Power on the UUT's Operator Control Unit (OCU). Verify OCU is completely powered on before proceeding to the next step.
8. Open the chamber for no more than 1-minute maximum; install batteries into the UUT and power on UUT.
9. Connect and verify communication to the UUT
10. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.
11. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
12. If an invalid test, note the error or conditions which resulted in the end of test.

Maximum Normal Speed Test, -20 C

1. Measure and record State of Charge on 2 fully charged BB-2590 batteries (NSN 6140-01-490-4316, 6.8 Ah @ 28.8 V).
2. Place loading device, UUT and the 2 batteries inside the temperature chamber. The batteries are not to be installed in the UUT at this time.
3. Install ambient temperature sensor inside the chamber to measure inside air temperature. Rate of datalogging should be at least 0.1 Hz.
4. Monitor and log the power bus voltage of the platform.
5. Bring temperature of chamber to -20 C and soak UUT and batteries for 2 hours.
6. Begin logging of data, monitoring power bus voltage.
7. Power on the UUT's Operator Control Unit (OCU). Verify OCU is completely powered on before proceeding to the next step.
8. Open the chamber for no more than 1-minute maximum; install batteries into the UUT and power on UUT.
9. Connect and verify communication to the UUT
10. Hold the robot speed at 100% maximum platform speed in Normal mode on level ground. This speed will be kept constant for the entire test.
11. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.
12. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
13. If an invalid test, note the error or conditions which resulted in the end of test.

Maximum Normal Speed Test, +25 C

1. Measure and record State of Charge on 2 fully charged BB-2590 batteries (NSN 6140-01-490-4316, 6.8 Ah @ 28.8 V).
2. Place loading device, UUT and the 2 batteries inside the temperature chamber. The batteries are not to be installed in the UUT at this time.
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4. Monitor and log the power bus voltage of the platform.
5. Bring temperature of chamber to +25 C and soak UUT and batteries for 2 hours.
6. Begin logging of data, monitoring power bus voltage.
7. Power on the UUT's Operator Control Unit (OCU). Verify OCU is completely powered on before proceeding to the next step.
8. Open the chamber for no more than 1-minute maximum; install batteries into the UUT and power on UUT.
9. Connect and verify communication to the UUT
10. Hold the robot speed at 100% maximum platform speed in Normal mode on level ground. This speed will be kept constant for the entire test.
11. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.

12. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
13. If an invalid test, note the error or conditions which resulted in the end of test.

Maximum Normal Speed Test, +50 C

1. Measure and record State of Charge on 2 fully charged BB-2590 batteries (NSN 6140-01-490-4316, 6.8 Ah @ 28.8 V).
2. Place loading device, UUT and the 2 batteries inside the temperature chamber. The batteries are not to be installed in the UUT at this time.
3. Install ambient temperature sensor inside the chamber to measure inside air temperature. Rate of datalogging should be at least 0.1 Hz.
4. Monitor and log the power bus voltage of the platform.
5. Bring temperature of chamber to +50 C and soak UUT and batteries for 2 hours.
6. Begin logging of data, monitoring power bus voltage.
7. Power on the UUT's Operator Control Unit (OCU). Verify OCU is completely powered on before proceeding to the next step.
8. Open the chamber for no more than 1-minute maximum; install batteries into the UUT and power on UUT.
9. Connect and verify communication to the UUT
10. Hold the robot speed at 100% maximum platform speed in Normal mode on level ground. This speed will be kept constant for the entire test.
11. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.
12. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
13. If an invalid test, note the error or conditions which resulted in the end of test.

Maximum Fast Speed Test, -20 C

1. Measure and record State of Charge on 2 fully charged BB-2590 batteries (NSN 6140-01-490-4316, 6.8 Ah @ 28.8 V).
2. Place loading device, UUT and the 2 batteries inside the temperature chamber. The batteries are not to be installed in the UUT at this time.
3. Install ambient temperature sensor inside the chamber to measure inside air temperature. Rate of datalogging should be at least 0.1 Hz.
4. Monitor and log the power bus voltage of the platform.
5. Bring temperature of chamber to -20 C and soak UUT and batteries for 2 hours.
6. Begin logging of data, monitoring power bus voltage.
7. Power on the UUT's Operator Control Unit (OCU). Verify OCU is completely powered on before proceeding to the next step.
8. Open the chamber for no more than 1-minute maximum; install batteries into the UUT and power on UUT.
9. Connect and verify communication to the UUT

10. Hold the robot speed at 100% maximum platform speed in Fast mode on level ground. This speed will be kept constant for the entire test.
11. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.
12. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
13. If an invalid test, note the error or conditions which resulted in the end of test.

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7. Power on the UUT's Operator Control Unit (OCU). Verify OCU is completely powered on before proceeding to the next step.
8. Open the chamber for no more than 1-minute maximum; install batteries into the UUT and power on UUT.
9. Connect and verify communication to the UUT
10. Hold the robot speed at 100% maximum platform speed in Fast mode on level ground. This speed will be kept constant for the entire test.
11. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.
12. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
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9. Connect and verify communication to the UUT
10. Hold the robot speed at 100% maximum platform speed in Fast mode on level ground. This speed will be kept constant for the entire test.
11. Test is completed when robot shuts off due to loss of battery power. Any other end of test results in an invalid test.
12. If a valid test, record the amount of time from the start of the test until the robot shut off. Also record the SOC of the two batteries.
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TARDEC Battery Rundown Test Form

PackBot Performance Test

Start Date	
Start Time	
Robot Serial Number	
Tester Name	
Chamber Temperature (C)	
Test Type	
Trial Number	
Test Number	
Data File Name	
Left Front Battery S/N	
Starting SOC (%)	
Ending SOC (%)	
Left Front Battery S/N	
Starting SOC (%)	
Ending SOC (%)	
Valid Test?	
Did the UUT remain in chamber for at least 2 hours before start of test?	
Did the data logger start recording prior to powering on the UUT?	
Was the battery SOC verified before installing the batteries in the UUT?	
Did the batteries remain uninstalled for at least 2 hours before the start of test?	
Notes	